

REMARKS

Applicants respectfully request consideration of the following remarks.

Anticipation Rejections Under 35 U.S.C. § 102

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989).

Anticipation Rejection Based on U.S. Patent Application 2004/0157407 to Tong et al.

Claims 1-6 and 13-21 were rejected under 35 U.S.C. § 102(e) as being anticipated by United States Patent Application 2004/0157407 to Tong et al. (hereinafter “Tong”). Applicants respectfully traverse this rejection, as set forth below.

Tong does not disclose the method recited in each of independent claims 1 and 13, as amended. Note that, in all embodiments disclosed in Tong, the regions of the wafer surfaces surrounding the contacts are chemically bonded, and it is this chemical bond between the non-contact regions of the wafers that causes contact pressure bonding to occur between the metal contacts (or, alternatively, the chemical bond may facilitate a post-bond reflow). See, e.g., paragraphs 0022, 0047, 0050, 0066, 0067, 0083, 0084, 0095, and 0100 of Tong.

In contrast to Tong, in the claimed embodiments, “*all* regions of the first and second wafer surfaces surrounding the mating conductors remain unbonded,” as recited

in each of claims 1 and 13. Thus, claims 1 and 13 are novel in view of Tong and, further, claims 2-6 and 14-21 are allowable as depending from novel independent claims 1 and 13, respectively.

In response to the Applicants' argument set forth above, the Examiner states the following:

[I]n Fig. 2b Tong et al. teaches mating the conductors, which forms a bond, while the wafer regions surrounding the conductors remain unbonded. Claims 1 and 13 do not limit the manner of bonding, and forming a metal-to-metal contact, as disclosed by Tong et al. in Fig. 2b, is a manner of forming a bond, as detailed in paragraph 0060 of Tong et al. Office Action, at pg. 8.

The Examiner has, respectfully, misconstrued the teachings of Tong, and Tong does not disclose the formation of metal-to-metal bonds simply by providing contact between the metal bond pads. As noted at the outset of Tong in paragraph 0047, both figures 1 *and* 2 are directed to a first embodiment of the disclosed bonding method, wherein "direct metal-metal bonding is generated when metal contact regions on separate wafers upon alignment are **contact pressure bonded by the intrinsic forces generated when non-metallic regions peripheral to the metallic regions undergo room-temperature chemical bonding.**"

As further stated in paragraph 0050 of Tong:

Due to the malleability and ductility of the metal bonding pads, the pressure generated by the chemical wafer-to-wafer bonding in the non-metal regions may result in a force by which nonplanar and/or rough regions on the metal pads may be deformed resulting in improved planarity and/or roughness of the metal pads and intimate contact between the metal pads. The pressure generated by the

chemical bonding is sufficient to obviate the need for external pressure to be applied in order for these metal pads to be intimately contacted to each other. A strong metallic bond can be formed between the intimately contacted metal pads, even at room temperature, due to inter-diffusion or self-diffusion of metal atoms at the mating interface.

Thus, clearly it is the chemical bonding in the non-metal regions that initiates and causes bonding to occur at the metal-to-metal interfaces. Further, according to Tong, the pressure generated by this chemical bonding causes the malleable metal pads to deform and become more planar, resulting in “intimate” contact between the metal pads, and it is these “intimately” contacted metal pads at which strong metallic bonds can be formed. Reference is again made to these “intimately” contacted pads in paragraph 0060 (upon which the Examiner relies), which is discussed further below.

In support of the Examiner’s position that Tong teaches the formation of a bond by providing only metal-to-metal contact, the Examiner makes reference to paragraph 0060 of Tong, as well as FIG. 2b. However, paragraph 0060 simply describes some examples of the first embodiment of the bonding process, which has been summarized above, and several statements in Tong support this conclusion, as summarized below:

(1) Paragraph 0060 again makes reference to the need for intimate contact, stating “As **mentioned above**, a strong metallic bond can be formed between the **intimately** contacted metal pads . . .”. As previously noted, it is the pressure generated by the chemical bonding of the non-metal regions that creates this intimate contact.

(2) As stated toward the end of paragraph 0060, “Thinner metals require lower temperatures for bonding than thicker metals due to higher pressure generated by the **bonding of non-metal surrounding areas.**” Thus, it is clear that paragraph 0060 is

continuing to make reference to the first embodiment disclosed in Tong, wherein the metal-to-metal bonds are formed by the chemical bonding that occurs in the non-metal regions.

(3) FIGS. 1a-1c and FIGS. 2a-2c are both describing the same embodiment, as noted above, with FIGS. 2a-2c illustrating an embodiment where “gaps between two bonding wafers or dies can be reduced leaving a small unbonded area around each metal pad.” See paragraph 0051. The figures 1b and 2b are analogous in that each shows contact between the metal pads on the mating wafers prior to the start of chemical bonding of the non-metal regions and, as stated in paragraph 0049 of Tong, “FIG. 1B shows the wafers upon placing the wafers together to contact the respective pads. **At this stage, pads 12, 15 would be separable.**”

Thus, in summary, Tong discloses a process in which metal-to-metal bonds are formed between mating bond pads as a result of chemical bonding that occurs in the non-metallic regions of the wafers. Accordingly, Tong does not disclose the formation of metal-to-metal bonds between bond pads on two mating wafers, wherein all other regions on the wafers remain unbonded. Again, chemical bonding of the non-metallic regions is necessary in order for metal-to-metal bonding to occur, and prior to such chemical bonding the wafers remain “separable”.

Obviousness Rejections Under 35 U.S.C. § 103

To reject a claim or claims under 35 U.S.C. § 103, the Examiner bears the initial burden of establishing a prima facie case of obviousness. M.P.E.P. § 2142. When

establishing a prima facie case of obviousness, the Examiner must set forth evidence showing that the following three criteria are satisfied:

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references (or references when combined) must teach or suggest all the claim limitations. M.P.E.P. § 2143.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on the applicant's disclosure. M.P.E.P. § 2142 (citing *In re Vaeck*, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991)). Also, the evidentiary showing of a motivation or suggestion to combine prior art references "must be clear and particular." *In re Dembiczak*, 175 F.3d 994, 999, 50 U.S.P.Q.2d 1614, 1617 (Fed. Cir. 1999).

Obviousness Rejection Based on U.S. Patent Application 2004/0157407 to Tong et al. in View of Wolf et al., Silicon Processing for the VLSI Era, vol. 1, 1986

Claims 7 and 22 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Tong in view of Wolf et al., Silicon Processing for the VLSI Era, vol. 1, 1986 (hereinafter "Wolf"). Applicants respectfully traverse this rejection, as set forth below.

As noted above, Tong fails to disclose all limitations of independent claims 1 and 13. Wolf, either individually or in combination with Tong, also fails to disclose all limitations of independent claims 1 and 13. If an independent claim is nonobvious, then any claim depending from the independent claim is also nonobvious. M.P.E.P. §2143.03

(citing *In re Fine*, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988)). Therefore, claims 7 and 22 are allowable as depending from nonobvious independent claims 1 and 13, respectively.

Obviousness Rejection Based on U.S. Patent Application 2004/0157407 to Tong et al. in View of U.S. Patent Application 2002/0027294 to Neuhaus et al.

Claims 8-11 and 23-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Tong in view of United States Patent Application 2002/0027294 to Neuhaus et al. (hereinafter “Neuhaus”). Applicants respectfully traverse this rejection, as set forth below.

As noted above, Tong fails to disclose all limitations of independent claims 1 and 13. Neuhaus, either individually or in combination with Tong, also fails to disclose all limitations of independent claims 1 and 13. If an independent claim is nonobvious, then any claim depending from the independent claim is also nonobvious. M.P.E.P. §2143.03 (citing *In re Fine*, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988)). Therefore, claims 8-11 and 23-26 are allowable as depending from nonobvious independent claims 1 and 13, respectively.

Claim Objections - Allowable Subject Matter

Claims 12 and 27 were objected to as being dependent upon a rejected base claim, but each of these claims would be allowable if rewritten in independent form. Office Action, at page 8. As set forth above, each of independent claims 1 and 13 is patentable in view of the cited prior art. Thus, Applicants submit that each of claims 12 and 27 is patentable as written in dependent form.

CONCLUSION

Applicants submit that claims 1-27 are in condition for allowance and respectfully request allowance of such claims.

Please charge any shortages and credit any overages to Deposit Account No. 02-2666.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the below date with sufficient postage in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450

Signature: Theresa Belland 10/03/06
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